

PATENT APPLICATION

TRACKING SOLAR SHELTER

5 CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims the benefit of the filing of U.S. Provisional Patent Application Serial No. 60/452,828, entitled "Tracking Solar Array", filed on March 7, 2003, and the specification thereof is incorporated herein by reference.

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BACKGROUND OF THE INVENTION

Field of the Invention (Technical Field):

The present invention relates to a solar tracking, solar power generating shelter, particularly 15 useful for vehicles.

Description of Related Art:

Note that the following discussion refers to a number of publications by author(s) and year of publication, and that due to recent publication dates certain publications are not to be considered as 20 prior art vis-a-vis the present invention. Discussion of such publications herein is given for more complete background and is not to be construed as an admission that such publications are prior art for patentability determination purposes.

Methods and devices for generating electric power using solar tracking panels are known. 25 However, such solar systems are either fixed or are dual tracking. The dual tracking systems are, consequently, limited to being disposed on one vertical support structure and must utilize complex support systems to confer sufficient structural integrity to avoid being affected by adverse natural or man-made forces. They cannot be linked to form larger systems.

For example, U.S. Design Patent No. 408,554 discloses a solar shade system, but it does not track the movement of the sun. Applicant has also constructed a solar carport, but it is distinguishable from the present invention in various regards, including the absence of solar tracking capabilities. U.S. Patent No. 4,995,377 discloses a tracking solar array, but it is dual-axis tracking and cannot be linked to other such devices. U.S. Patent No. 6,058,930 discloses a single-axis tracking device, but it relies on a complex apparatus to lend structural and mechanical integrity and strength. Japanese Patent No. JP2002194912 discloses a solar carport, but it cannot be linked to provide larger area coverage and does not track the sun's movement.

10 Therefore, solar tracking capacity has not been applied to larger solar array systems. The prior art does not address the need to maximize the use of space dedicated to larger solar power systems and to simultaneously maximize the amount of solar energy that can be collected.

BRIEF SUMMARY OF THE INVENTION

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The present invention comprises a shelter-providing solar tracking assembly comprising solar power arrays and an inverter to convert energy from direct current to alternating current. Each array comprises solar panels that comprise photovoltaic cells. The solar power arrays are disposed on support structures comprising beams, trusses, and vertical support pillars. The solar power arrays are 20 movable on a single-axis and are connected to a drive mechanism so that they can track the movement of the sun. The solar power arrays form an overhead shelter for items located beneath them. The solar power arrays provide electrical power to a building or structure located near them.

25 The assembly may comprise a back-up generator, batteries to store generated power, an electric output connector. The assembly may provide a shelter for vehicles located beneath the solar power arrays.

A primary object of the present invention is to provide for portable renewable solar energy while simultaneously providing shelter for vehicles.

A primary advantage of the present invention is that it minimizes the need for space to situate a

5 solar power array.

Another advantage of the present invention is that it tracks solar energy so that it maximizes the amount of solar energy that is harnessed.

10 Other objects, advantages and novel features, and further scope of applicability of the present invention will be set forth in part in the detailed description to follow, taken in conjunction with the accompanying drawings, and in part will become apparent to those skilled in the art upon examination of the following, or may be learned by practice of the invention. The objects and advantages of the invention may be realized and attained by means of the instrumentalities and combinations particularly 15 pointed out in the appended claims.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

The accompanying drawings, which are incorporated into, and form a part of, the specification, 20 illustrate one or more embodiments of the present invention and, together with the description, serve to explain the principles of the invention. The drawings are only for the purpose of illustrating one or more preferred embodiments of the invention and are not to be construed as limiting the invention. In the drawings:

25 Fig. 1 is a top perspective view of the preferred embodiment of the present invention;

Fig. 2 is a top perspective view of the embodiment of Fig. 1 showing the support structure;

Fig. 3 is a top perspective view of the support pier of the embodiment of Fig. 1;

Fig. 4 is a top perspective view of the rebar structure of the support pier of the embodiment of

Fig. 1;

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Fig. 5 is a top perspective view showing the photovoltaic modules of the embodiment of Fig. 1;

Fig. 6 is a top perspective view of the embodiment of Fig. 1 showing the array support tube;

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Fig. 7a shows a perspective view of the rotor bearing assembly of the embodiment of Fig. 1;

Fig. 7b shows a perspective view of the drive assembly of the embodiment of Fig. 1;

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Fig. 8 shows a perspective view of the end coupler tube and array support tube of the embodiment of Fig. 1;

Fig. 9a shows a perspective view of the drive assembly and its support pillar of the embodiment of Fig. 1;

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Fig. 9b shows a perspective view of the drive assembly of the embodiment of Fig. 1;

Fig. 10a shows a perspective view of the rotor bearing assembly and its support pillar of the embodiment of Fig. 1;

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Fig. 10b shows a perspective view of the rotor bearing assembly of the embodiment of Fig. 1;

Fig. 11 shows a bottom perspective view of the solar array support structure of the embodiment of Fig. 1; and

Fig. 12 shows a top perspective view of a solar array panel and supporting truss structure of
5 the embodiment of Fig. 1.

DETAILED DESCRIPTION OF THE INVENTION

The present invention is a solar tracking, solar power array that provides shelter, particularly for
10 vehicles. The shelter comprises a single-axis solar tracking apparatus and solar panels disposed in such a way that shelter is provided to items disposed beneath the solar panel array such as vehicles (e.g., cars, trucks, etc.) parked beneath the solar panel array. The tracking solar array preferably includes the solar power array assemblies coupled with rotor bearings and drive assemblies that include drive actuators on a torque rotator assembly held by pillars.

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This array preferably uses pre-engineered, pre-manufactured solar sections which are made to recognized engineering standards and specifications. The preferred embodiment of the present invention is based on a photovoltaic system operating in a grid-tied configuration.

20 The preferred embodiment uses a photovoltaic system which is capable of single-axis tracking which will provide the attached building with up to 25% more power than a fixed solar structure. The photovoltaic system preferably utilizes generators to provide for back-up power. In the alternative, storage batteries may be utilized.

25 Each section of the solar array follows the movements of the sun. Parts of the array can be fixed while other sections track the sun for optimal solar power. The solar array preferably tracks the sun and thereby moves in the direction of the sun so that the maximum energy is produced. The structure may be positioned to track in a North-South orientation or in an East-West orientation. The preferred

tracking system allows the array to follow the sun throughout the day if its longitudinal axis is positioned in a North-South configuration. If the longitudinal axis is positioned in an East-West configuration, the preferred tracking system follows the sun's seasonal movement from north to south.

5 Turning now to the figures, which illustrate the preferred embodiment of the invention, Fig. 1 shows solar tracking vehicle shelter **20** comprising solar array assembly **22**. Solar array assembly **22** comprises solar modules **24**. There are preferably twenty solar modules **24** (of preferably 105 watts each) per solar array assembly **22**. Although three solar array assemblies **20** are depicted in the figures, any number of solar array assemblies **22** may comprise solar tracking shelter **20** as desired.

10 Solar array assemblies **22** are supported by solar array support structure **50** and array support tube **56**, both of which are shown in Fig. 2, which in turn are supported by bearing assembly support pillar **26** and drive assembly support pillar **28**. Support pillars **26, 28** are supported by, and attached to, piers **30**. Support pillars **26, 28** and entire solar array support structure **50** are preferably constructed of steel, but may be constructed of any rigid material suitable for the purpose of providing support, and piers **30** are

15 preferably constructed of concrete, but may be constructed of any material sufficient to provide support. Attached to array support tube **56** and support pillar **26** is rotor bearing assembly **34**. Attached to array support tube **56** and support pillar **28** is drive assembly **32**. Preferably, the number of rotor bearing assemblies **34** is equal to the number of solar array assemblies **22**. The solar tracking shelter preferably comprises one drive assembly **32**.

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Fig. 2 shows solar array support structure **50** comprising array support tube **56**, truss assembly **52**, and edge guard **54**. Solar modules **24** attach to solar array support structure **50**. Support structure **50** is preferably constructed of steel, another metal, or other similarly rigid material.

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Fig. 3 shows pier **30** with attached attachment plate **40**. Fig. 4 shows preferred rebar structure **42** that supports the concrete of which pier **30** is preferably constructed. Attachment plate **40** preferably attaches to pier **30** via J-bolts although other fasteners known in the art may be used.

Fig. 5 is another view showing solar array assembly 22 disposed on truss assembly 52, rotor bearing assembly 34 disposed on support pillar 26, drive assembly 34 disposed on drive assembly 28. Also shown are DC power disconnect 38 and DC to AC power inverter 36, both preferably disposed on support pillar 26. Inverter 36 is preferably 2.5 kW.

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Fig. 6 shows array support tube 56 connected to drive assembly 32 and rotor bearing assembly 34. Also shown is tracking drive mechanism 48 disposed on support pillar 28. Drive assembly 32 comprises a drive actuator assembly that is preferably grid-tied to solar array assembly 22 and to generators (not shown), if utilized, for controlling movement of solar array assembly 22. In the preferred 10 embodiment, drive assembly 32 is controlled by drive mechanism 48.

Fig. 7a is an exploded view of rotor bearing assembly 34. Disposed on mounting plate 44 of support pillar 26 is mounting bracket 67 which in turn holds bearing housing 62. Bearing housing 62 is disposed within sleeve bearing 60. Within bearing housing 62 turns coupler tube 64. Coupler tube 64 15 also turns within end coupler torque tube 66 which is fixed onto end plate 68 of array support tube 56.

Fig. 7b is an exploded view of drive assembly 32. Disposed on mounting plate 47 of support pillar 28 is base plate 80. Disposed on base plate 80 is face plate 73 to which coupler tube 70 and coupler plate 74 are disposed. Coupler tube 70 turns within end coupler torque tube 66.

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Fig. 8 is an exploded view of end coupler torque tube 66 fixed onto end plate 68 of array support tube 64.

Fig. 9a is another view showing drive assembly 32 disposed via base plate 80 to support pillar 25 28. Support pillar 28 is attached via pillar attachment plate 45 to attachment plate 40 of pier 30. Fig. 9b is an exploded view of drive assembly 34. Base plate 80 is attached to mounting plate 47. Face plate 73 is attached to base plate 80. Coupler tube 70 turns within face plate 73. Shroud 72 surrounds 28 coupler plate 74. Also shown are spacers 76 which attaché back angle supports 78 to face plate 73.

Fig. 10a is another view of rotor bearing assembly 34 attached to support pillar 26 which attaches to attachment plate 40 of pier 30 via pillar attachment plate 49. Also shown are inverter 36 and DC disconnect 38. Fig. 10b shows mounting bracket 67 attached to mounting plate 44. Attached to 5 mounting bracket 67 is sleeve bearing 60 which houses bearing housing 62. Within bearing housing 62 turns coupler tube 64. Fasteners 63 fasten coupler tube to end coupler torque tube 66.

In the preferred embodiment, each solar array assembly 22 is disposed on one solar array support structure 50 with one array support tube 56. Array support tubes 56 may be linked together via 10 end coupler tube 66 of array support tube 56 and coupler tube 64 of rotor bearing assembly 34 and/or coupler tube 70 of drive assembly 32. Therefore, any number of solar array assemblies may be linked to form any size solar tracking structure 20. Solar array assembly 22 may therefore be assembled off-site then linked to other solar array assemblies 22 on-site as desired.

15 Fig. 11 shows the underside of solar array support structure 50. Truss assembly 52 comprising angle strut 100, mounting rail 102, and mounting clamp 104 is shown. Edge guard support 54 is also shown. Solar array assembly 22 attaches to mounting rail 102 and edge guard support 54. Truss assembly 52 attaches to array support tube via mounting claim 104. Also shown in Fig. 11 are electrical junction box 82 and electrical conduit 84 preferably incorporated into solar tracking vehicle shelter 20 to 20 conduct the solar power into a building electrical interface box or other interface (e.g., remote or attached, not shown) so that a nearby building or structure may utilize the solar power from solar tracking vehicle shelter 20.

25 Fig. 12 is an exploded view of solar modules 24 comprising frames 90 disposed on truss assembly 52 via mounting rail 102. Angle strut 100 and mounting claim 104 attach to array support tube with the aid of clamp fasteners 106.

Also a part of solar tracking vehicle shelter **20** are appropriate disconnects (not shown), safety switches (not shown) and combiner boxes (not shown) for each solar array assembly **22**. Any number of solar modules **24** may be utilized. Likewise, different wattages for the components may be utilized.

5 Smaller, individualized inverters **36** minimize the impact of inverter failure on solar array assembly **22** and are easily replaced. The energy produced from the solar array assembly **22** is transferred to an electrical interface box (not shown) in a nearby building or structure.

10 Generators (not shown), if utilized, are preferably two generators (e.g., 60kW), one generator e.g., 20kW) and transfer switches (e.g., three) per solar array assembly **22**. Solar array assembly **22** preferably has pre-manufactured cells, but the structure of the array is built on-site and preferably includes a building electrical interphase such as electrical junction box **82**.

15 Solar tracking vehicle shelter **20** is preferably used as a carport, but may alternatively be used as a shelter for any purpose such as, for example, a weather structure, a porch, or similar structure. Solar array assembly **22** protects and shields the items in the spaces under solar array assembly **22** while providing energy to the attached or nearby building or structure. If solar tracking vehicle shelter **20** is used as a carport, each solar array assembly **22** may accommodate up to two full-sized vehicles.

20 In other alternative embodiments solar tracking vehicle shelter **20** may include optional solar array assembly **22** or more generators.

Example

25 A solar tracking carport was constructed in accordance with the present invention. There were included twenty Photowatt PW 1250 PV modules per solar array assembly, a 600 Vdc DC disconnect with enclosure per solar array assembly, one 2.5kW inverter per solar array assembly, a single-axis tracking array apparatus, an AC service panel with enclosure, an AC/Utility main disconnect, 125 watt photovoltaic modules, and disconnects, safety switches and combiner boxes for each section.

Each solar array assembly measured approximately 24 feet in length, approximately 12 feet in width, and the bottom edge of each array rose approximately 8 feet, 6 inches in height off the ground.

5 Although the invention has been described in detail with particular reference to these preferred embodiments, other embodiments can achieve the same results. Variations and modifications of the present invention will be obvious to those skilled in the art and it is intended to cover in the appended claims all such modifications and equivalents. The entire disclosures of all references, applications, patents, and publications cited above are hereby incorporated by reference.